Amendments to the Specification

Please amend the first full paragraph of the Background of the Invention on page 1 of the specification, which extends from line 13 to line 24 as follows (the change is in line 20 of page 1):

In wireless networks employing General Packet Radio Service (GPRS), a coding scheme for data message transmissions is selected by rules embedded in a fixed network and in a mobile station that are designed to result in the highest data throughput with the fewest possible retransmissions. GPRS is an extension of circuit-switched networks and data transmission services that uses packet radio transmissions to carry data messages using protocols such as Internet Protocol (IP) or X.25 information from mobiles to the network and ~~visa~~ vice versa, in data blocks, or packets. GPRS is an extension to the circuit switched Global System for Mobile communications (GSM), having four different coding schemes with effective data rates of 9.05, 13.4, 15.6 and 21.4 kilobits per second (code rates 1/2, 2/3, 3/4 and 1) when using one of the eight time slots available within a TDMA frame.

Please amend the second full paragraph of the Background of the Invention that extends from page 1, line 25 of the specification to page 2, line 12 as follows (The change, at page 2, line 9, is for an obvious typographical error):

Some GPRS-enabled fixed networks can transmit data to a mobile station, such as a cell phone, an Internet-enabled mobile phone or a personal digital assistant, using a selected one of the four coding schemes. However, the mobile unit may have resource limitations that prevent it from accepting data at some of the higher coding schemes, such as an effective data rate that is less than the maximum data rate that the mobile unit supports. Such a resource limitation arises when the mobile unit is coupled to a peripheral device using an effective downlink data transfer rate that is less than the maximum downlink radio channel data rate that the mobile unit can support. For example a mobile unit may act as a radio frequency modem for a personal computer (the peripheral, for the purposes of this document) that is coupled to the mobile unit by a serial link that has an effective data rate less than the effective data rate of the RF downlink. Another inherent resource limitation is a finite depth of a buffer memory of the mobile unit used to buffer data being sent to the peripheral device through the mobile unit. The fixed network can send data to the mobile station at a data rate greater than the effective downlink data rate determined by the link between the mobile unit and the peripheral, and the mobile unit can accept and acknowledge that data, until the buffer is full. At that time, the mobile unit has to

~~being~~ begin rejecting some of the downlink data packets. With the move toward third-generation network standards, there are even more possible problems of these types with high-performance networks that use a wider variety of coding schemes.

Please amend the paragraphs of the Brief Description of the Drawings that extend from page 3, line 31 of the specification to page 4, line 3 as follows:

FIG. 14 is ~~a time plot that shows data packets as an initial data message having a long set of data is being sent to a mobile station~~ an optional embodiment of a step of a method described with reference to FIG. 8, in accordance with some embodiments of the present invention; ~~and~~

FIG. 15 ~~is a time plot of another data message having a long set of data, in accordance with some embodiments of the present invention.~~ is a time plot that shows data packets as an initial data message having a long set of data is being sent to a mobile station; and

~~Should figure 16 have an entry here?~~

FIG. 16 is a time plot that shows data packets of another data message having a long set of data, in accordance with some embodiments of the present invention.

Please amend the paragraph of the Detailed Description that extends from page 7, line 4 of the specification to page 8, line 2 as follows (the change is at line 2 of page 8):

The data packets may be digitally encoded using a coding scheme (codes). The term scheme and code may be used interchangeably as appreciated by those skilled in the art. These schemes may be used in a variety of combinations with one or more received data packets. The transmission of data packets may use one or more modulation schemes, such as 16-QAM (quadrature amplitude modulation) or 8-PSK (phase shift keying).
The modulation schemes and encoding schemes may be adaptively chosen based on factors such as requisite bit error rates (BER) or channel quality attributes. In accordance with the present invention, coding schemes are characterized in an ordinal relationship to each other, so that there are higher and lower coding schemes, with the higher coding schemes generally providing higher effective data throughput (Le., the data rate not including error protection bits), and correspondingly requiring better environmental conditions to achieve sufficiently error free effective data throughput. Conversely, lower coding schemes generally employ either more

redundant information or use slower modulation techniques to achieve effective data throughput that is similarly error free. Also, changing the coding scheme from a lower coding scheme to a higher coding scheme is referred to herein as raising the coding scheme, and conversely, a coding scheme can be lowered to a lower coding scheme. A successful transmission of multiple data packets comprising a data message may involve at least one additional transmission attempt (retransmission) of specific data packets whose contents were unsuccessfully decoded at the receiver. The retransmission may comprise a repeated transmission of the data packet that was corrupted in the channel. The retransmission may be sent at a lower coding scheme to improve the reliability of the data. The retransmission may also be sent using the same coding scheme, such as a repeated transmission. The retransmission may be sent at a higher coding scheme for faster data throughput. The coding scheme selection may be determined, for example, with feedback from wireless data device **180**, by a data scheme selected by the packet control unit (PCU) portion of the BSC/PCU **150** and communicated to the BTS **160**. A detailed description of some of the rules for selecting a coding scheme is given below with reference to ~~FIGS. 7-9~~ **FIGS. 7-9**.

Please amend the paragraph of the Detailed Description that extends from page 10, line 16 of the specification to page 10, line 31 as follows (the change is at line 29 of page 10):

For example, layer 2 user data bits received by the PCU **254** from the IP internet **220** via the GSN **240** (resulting from a particular software application) are in the form of Logic Link Control (LLCs) frames. Upon receipt, the PCU **254** splits each of the LLCs into segments of bits and inserts additional bits (e.g., polling bits, data encoding instructions, etc.). The resulting blocks of bits, herein referred to as "segmented blocks," are forwarded to the BTS **260** for transmission as a downlink data message. Based on the data encoding instructions embedded in the segmented blocks by the PCU **254**, the segmented blocks are encoded, or modulated, by the BTS **260** using the GPRS coding schemes, and the downlink data message is transmitted to the MS **270** as GPRS radio blocks. Similarly, a data message can be generated by the mobile data device **280** and transmitted from the MS **270** using the GPRS coding schemes. Current GPRS coding schemes selectable by the PCU **254** include Coding Scheme 1 (CS-1), CS-2, CS-3, or CS-4 (~~see, FIGS. 3-6~~ **see FIGS. 2-6**) and Modulated Coding Scheme 1 (MCS-1), MC8-2, MCS-3, MCS-4, MCS-5, MCS6, MCS-7, MCS-8, and MC8-9.

Please amend the paragraph of the Detailed Description that extends from page 10, line 32 of the specification to page 11, line 4 as follows (the change is at line 4 of page 11):

The particular GPRS coding scheme selected by the PCU **254** and MS **270** is based on whether the data is control data requiring maximum protection for transmitted bits, or maximum data integrity, requiring CS-1 coding, or whether the data is user data. If the data is user data, varying coding schemes (e.g., CS-1 through CS-4) are selected by the PCU **254**, generally based on channel quality factors and knowledge of the coding scheme capabilities of the MS **270**, as described in more detail with reference to ~~FIGS. 7 and 8~~ **FIGS. 7** and **8** below.

Please amend the paragraph of the Detailed Description that extends from page 11, line 9 of the specification to page 12, line 7 as follow: (The change is at line 3 of page 12):

FIG. 3 is an illustration of coding scheme 1 (CS-1) **300** for maintaining maximum data integrity of GPRS radio blocks in a GPRS packet data transmission channel (PDTCH), in accordance with the preferred and alternative embodiments of the present invention. Referring to **FIG.** 3, for the CS-1 **300**, 181 Layer 2 bits resulting from applications (e.g., email, web browser, paging, etc.) as well additional information bits inserted by the PCU **254** are forwarded to the BTS **260** as a portion of a downlink data message (or possibly as a complete, short data message). (Of course, as is known, thousands of bits of layer 2 data may be received by the PCU **254** as a data message from a particular application). Based at least partially on the number of bits received and the information bits inserted by the PCU **254**, a predetermined number of uplink state flag (USF) bits **303** are added to the 181 Layer 2 bits **302** by the BTS **260**. The USF bits **303** are configured to notify a particular MS **270** that it has uplink transmission rights. Similarly, parity bits **304** and tail bits **306** are added to the 181 Layer 2 bits for error correction, herein referred to as a "block check sequence" (BCS). The addition of the USF bits **303**, the parity bits **304** and the tail bits **306** to the Layer 2 bits **302** results in 228 bits to be encoded. To maximize data integrity during transmission, each of the 228 bits of data is copied, resulting in 228 original bits and 228 copied bits for a total of 456 bits (Le., a 1/2 code rate) to be transmitted from the BTS **260** to the MS **270**. As is known in the art, each group of 456 bits may be referred to a one GPRS data block. The 456 bits are distributed among four "bursts" containing approximately 114 bits/burst (Le., one TDMA frame) shown in **FIG. 3** as bursts **308**,**309**,**310**,**311**. Thus, two copies of each the original 181 Layer 2 bits **302** are transmitted from the BTS **260**, thereby increasing the odds that each of the original 181 Layer 2

bits **302** are received by the MS **270**. Typically, the four bursts **308-311** are transmitted with forty-four additional bursts **312** (representing eleven additional GPRS radio blocks), and four idle bursts (i.e., TDMA frames) in a "multiframe" configuration. As shown in ~~FIGS. 3-6~~ **FIGS. 3-6,** a multiframe **320** is transmitted in approximately 240 milliseconds. Upon receipt of the multiframe(s) **320**, using well-known methods, bits inserted in the bursts by the BTS **260** at the direction of the PCU **254** are used by the MS **270** to decode and reconstruct the data is a form suitable for receipt by an end user.

Please amend the paragraphs of the Detailed Description that extend from page 21, line 11 of the specification to page 22, line 20 as follow: (A new paragraph is added preceding the original paragraphs at this location, and the figure numbers in the original paragraphs are updated. The new paragraph is supported by FIG. 14 and claim 18 in the application as originally filed. The changes in the specification for newly numbered FIGS. 15 and 16 is supported by the figure numbering in the application as originally filed. Thus, no new matter is added):

Referring to **FIG. 14**, an optional embodiment of step **855** of the method **800** that is described above with reference to **FIG. 8** is described, in accordance with certain embodiments. Step **1400** is the optional embodiment of step **855.** At step **1400**, data of a long set of data is transmitted to the mobile station using a combination of coding schemes that has a data rate exceeding a data rate of the optimal combination of coding schemes until the buffer depth of the mobile station is calculated to be filled, then the transmitted to the mobile station is continued using a combination of coding schemes having a data rate less than or equal to the data rate of the optimal combination of coding schemes for subsequent transmissions of data of the long set of data.

Referring to ~~**FIG. 14**~~ **FIG. 15**, a time plot shows data packets as an initial data message having a long set of data is being sent to a mobile station, in accordance with some embodiments of the present invention. Plot **1405** shows the coding scheme that is being used (values at right vertical axis), while plot **1410** shows the data rate approximately as a rolling average over four time slots (one frame). Initially, CS-4 is used at full duty cycle as the coding scheme combination. A high data rate (approximately 72 kbps) is achieved until the buffer in the mobile station fills, at which time **1415** an acknowledgment is missed. The duration from the start of the data message transmission until the missed acknowledgement is noted (**FIG. 13**, step **1310)**; at which time the coding scheme combination is changed to CS-3 at full duty cycle.

More acknowledgements are missed, while an average data rate of about 32 kbps is achieved, so the coding scheme combination is changed **1425** to CS-3 at 50% duty cycle and CS-2 at 50% duty cycle, and the average data rate increases to approximately 40 kbps. No acknowledgements are missed after a predetermined time, so a new combination of coding schemes is started **1430** that comprises CS-3 at 75% duty cycle and CS-2 at 25% duty cycle. No acknowledgements are missed using this new combination of coding schemes, and the most recent increment of data rate change was less than a precision limit, so the most recent combination of coding schemes becomes the optimal combination of coding schemes. The data rate for the optimal combination of coding schemes is approximately 51 kbps. This has been determined without the mobile station informing the fixed network of the transfer data rate (which, by inference, is greater than approximately 51 kbps and less than approximately 72 kbps). It will be appreciated that for messages of sufficient length, more combinations of coding schemes could be used to establish the optimal coding scheme combination very close to the actual data transfer rate. When the actual transfer data rate has been bracketed by the data rate of the optimal coding scheme combination and a data rate of a previous coding scheme combination, the buffer size is estimated using the faster of the two data rates, which in this example would be 51 kbps.

Referring to ~~**FIG. 15**~~ **FIG. 16**, a time plot shows data packets of another data message having a long set of data, in accordance with some embodiments of the present invention. The data is being sent to the same mobile station within a short period of time after the initial set of data that was sent, as described with reference to **FIG. 14.** (The short period of time should be less than the duration of the timer set at step **850.**) This set of data can now be transmitted more efficiently by using a combination of coding schemes that has a data rate exceeding a data rate of the optimal combination of coding schemes until the time **1505** at which the estimated buffer depth of the mobile station is calculated to be filled, then using the optimal combination of coding schemes **1510** (or, a slower combination of coding schemes could be used, as appropriate to accommodate other mobile stations) for subsequent transmissions of data of the long set of data.